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Remarks

Claims 39, 40, 50, 73-76 and 79-146 are pending in the application, with claims 39, 40, 50, 73-76, 84-99 and 101-146 having been withdrawn, and claims 79-83 and 100 having been rejected.[1]

Rejection of Claims 78-83 and 100 Under 35 U.S.C. §103

Claims 79-83 and 100 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,146,225 (Sheats et al.) in view of Japanese Patent No. 06-136159A (JP '159) and U.S. Patent No. 4,977,013 (Ritchie et al.), on grounds that:

"Sheats et al teaches a transparent, flexible permeability barrier for organic electroluminescent devices wherein a device is provided on a plastic substrate and a multilayer barrier coating is provided on either or both sides of the devices, wherein the

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[1] For the convenience of the Examiner, the rejected claims read in clean form as follows:

79. An electronic device on a plastic substrate, at least one side of the device being protected from reaction with or incorporation of moisture by a composite barrier comprising multiple layers of transparent conductive oxide separated by one or more vacuum-deposited in-situ polymerized organic layers.

80. A device according to claim 79 wherein the transparent conductive oxide comprises an indium tin oxide.

81. A device according to claim 79 further comprising an acrylic hardcoat.

82. A device according to claim 79 wherein a layer of the transparent conductive oxide has a sheet resistance less than 150 ohms/square.

83. A device according to claim 79 wherein the device comprises a light emissive device.

100. A device according to claim 79 wherein the device has at least two sides each of which is protected by such a composite barrier.

coating is preferably formed from two PML layers (wherein a PML layer is a vacuum deposited in-situ polymerized organic layer) with an inorganic oxide or nitride layer sandwiched therebetween (Abstract; Col. 2, line 39-Col 3, line 67.) Sheats et al. also teach that the anode layer 117 of conductive ITO that may be formed on a PML layer provided as a smoothing layer on the substrate and that a getter material such as a metallic lithium or other reactive metal may be added to the oxide or nitride layer or may be added as a separate layer between the multilayer barrier and the device (Col. 5, lines 18-Col. 6, lines 11.) Though Sheats discloses the use of a multilayer barrier of PML/oxide/PML, Sheats et al do not specifically teach the reverse sandwich structure of oxide/PML/oxide, or that the transparent oxide is a conductive transparent oxide. However, the use of transparent conductive layers on plastic substrates to provide the desired conductivity or resistivity such as for interference or antistatic properties in addition to transparency is well known in the art and further the use of transparent conductive oxides, such as ITO, in combination with other oxide or nitride layers in barrier coatings or films for display devices is also known in the art as taught by JP' 159 and Ritchie et al. It is particularly noted that Ritchie et al. teach that the barrier coating may comprise two non-conductive or dielectric layers sandwiching a conductive layer, similar to Sheats, or the conductive and nonconductive layers may be reserved (i.e. two conductive layers sandwiching a nonconductive or dielectric layer as in the instant claims), and also that multiple layers of each may be utilized such as two conductive layers and two nonconductive layers (Col. 4-5, Col. 7.) Hence, one having ordinary skill in the art at the time of the invention would have been motivated to utilize conductive and/or nonconductive oxide layers in the invention taught by Sheats et al., utilizing routine experimentation to determine the optimum number of layers and layer structure to provide the desired barrier and conductive properties for a particular end use, wherein ITO is a conventional and commonly preferred transparent conductive oxide material." (see the Office Action at pages 2-3, numbered paragraph 4).

Applicant requests reconsideration. Sheats et al. describe an OLED display **100** including *inter alia* a plastic substrate **161** on one side of which is a set of row electrodes (*viz.*, anodes)

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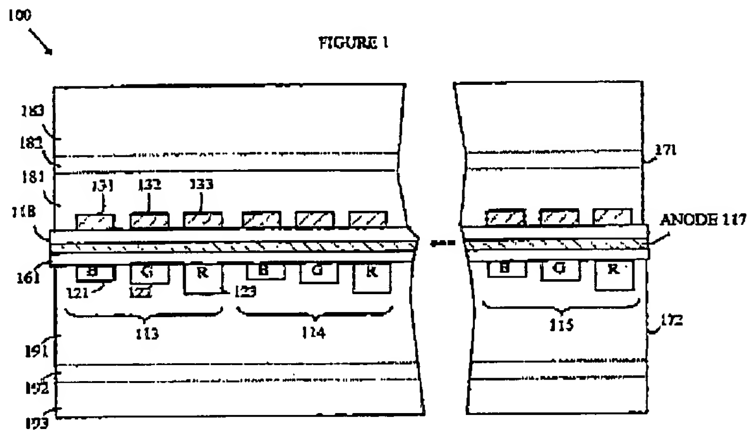
117, a light emitting layer **118**, a set of column electrodes (*viz.*, cathodes) **131**, **132**, **133**, etc., and an encapsulation layer **171** made from polymer layers **181** and **183** with an inorganic oxide or nitride layer **182** therebetween. On the other side of substrate **161** there is a set of color conversion strips **121**, **122**, **123**, etc. and an encapsulation layer **172** made from polymer layers **191** and **193** with an inorganic oxide or nitride layer **192** therebetween (see e.g., col. 2, line 39 through col. 3, line 28 and Fig. 1, reproduced below):



Applicant agrees that Sheats et al. "do not specifically teach the reverse sandwich structure of oxide/PML/oxide, or that the transparent oxide is a conductive transparent oxide". Applicant does not agree that a person having ordinary skill in the art would modify the number or arrangement of layers in Sheats et al. as proposed in the Office Action.

For example, Sheats et al. say when discussing OLED barrier films that "applying several polymer bilayers" (viz., of a layer of polymer and a layer of aluminum oxide, see col. 1, lines 48-53) "does not improve the resistance to water and oxygen sufficiently to provide the required increase" in water permeation resistance (see e.g., col. 1, lines 63-67). Sheats et al. say that their own invention instead involves applying an oxide or nitride layer at a higher density than previously taught (see e.g., col. 3, lines 59-67). A person having ordinary skill in the art would conclude from these statements that it would be undesirable and unnecessary to apply "several polymer bilayers" to the Sheats et al. barrier and that it would suffice merely to form a dense oxide or nitride layer as described by Sheats et al.

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Sheats al. also say that their barrier's hydrofluoric acid etch rate is "indicative of a water permeability of around 1×10^{-8} mol/m^2 day, 40 times better than the requirement for organic LEDs" (see col. 4, lines 34-52). A person having ordinary skill in the art would conclude from this statement that no further improvement in the Sheats et al. barrier would be needed. In other words, taking Sheats et al. at face value the experiments are over and further modifications are unnecessary. Thus a person having ordinary skill in the art who reviewed Sheats et al. would not have a proper basis for performing the "routine experimentation" proposed in the Office Action.

Applicant also does not agree that JP '159 or Ritchie et al. would provide a proper basis for a person having ordinary skill in the art to "utilize conductive and/or nonconductive oxide layers in the invention taught by Sheats et al., utilizing routine experimentation to determine the optimum number of layers and layer structure to provide the desired barrier and conductive properties for a particular end use, wherein ITO is a conventional and commonly preferred transparent conductive oxide material".

Ritchie et al. describe a transparent coating employing conductive and nonconductive layers of materials having substantially identical refractive indices (see e.g., col. 4, lines 65-68 and col. 5, lines 8-11). For the conductive layer Ritchie et al. use a wide band-gap semiconducting oxide, preferring ITO whose refractive index is said to be about 2.0 (see e.g., col. 5, lines 55-59 and col. 8, line 36). For the nonconductive layer Ritchie et al. use nonconductive (*viz.*, fully oxidized) versions of the semiconducting oxides, or other transparent nonconductive materials having a refractive index of about 2.0 (see e.g., col. 5, line 59 through col. 6, line 2). Ritchie et al. also say that different materials may be used for the conductive and nonconductive layers, but require that the refractive indices of such different materials be "substantially equal", *viz.*, that they differ by less than 0.2 from one another (see e.g., col. 7, lines 46-49 and col. 4, lines 65-68). Ritchie et al. do not say that a polymerized organic material could be used as the nonconductive layer, and do not refer to any polymerized organic material as having a refractive index "substantially equal" to the conductive polymer refractive index. Note in this regard that one table of refractive indices for various polymers, from the web page at http://www.plasticsusa.com/refract.html as it appeared on October 12, 1999 (shortly before the October 18, 1999 filing date of applicant's

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parent Application Serial No. 09/419,870), and as archived at http://web.archive.org/web/*/http://www.plasticsusa.com/refract.html, shows several polymers all of which have refractive indices of 1.633 or less. A PDF copy of the archive printout is enclosed with this response. If desired by the Examiner, applicant can submit this printout in a Supplemental Information Disclosure Statement (SIDS). Also, a November 12, 2003 news release from Nitto Denko Corporation entitled "Nitto Denko Develops Thermosetting Polymer with Highest Refractive Index" from the web page at http://www.japancorp.net/Article.Asp?Art_ID=5934 says that Nitto Denko had developed a 1.76 refractive index polymer which it believed to be the "highest level in the world". The Nitto Denko news release is dated after the filing date of applicant's parent application and would not be appropriate for submission in an SIDS, but a PDF copy of the cited web page is enclosed with this response. No polymeric materials that would meet Ritchie et al.'s refractive index matching requirements have been cited in the Office Action. Applicant submits that a person having ordinary skill in the art would not have been aware of any suitable polymeric materials. Thus if asked to consider the matter, a person having ordinary skill in the art would conclude that no polymeric materials suitable for use as Ritchie et al.'s nonconductive layer were available. Such a person would also conclude that a suitable transparent barrier could not be formed by (to use the words of the Office Action) "sandwiching" a layer of ITO between nonconductive polymeric layers, because the refractive indices of the ITO and available polymers would differ by more than Ritchie et al.'s "substantially equal" requirement.

JP '159 (a human translation of which was submitted by applicant on May 4, 2006) is similar to Ritchie et al. JP '159 describes a "transparent barrier film consisting of a metal oxide mainly comprising silicon oxide or metal nitride mainly comprising silicon nitride on a transparent film base and a transparent conducting film consisting of a metal oxide mainly comprising indium oxide" (see the translation at paragraph 0001). JP '159 does not describe any polymeric materials that might be substituted for its silicon oxide/silicon nitride layer, and does not provide a basis for a person having ordinary skill in the art to make such a substitution or to discard Ritchie et al.'s refractive index matching requirement.

Accordingly, a person having ordinary skill in the art would not utilize a polymeric layer in place of the Ritchie et al. nonconductive layer or in place of the JP '159 silicon oxide/silicon nitride layer, and would not utilize "routine experimentation to determine the optimum number of layers and layer structure to provide the desired barrier and conductive properties for a particular end use" as proposed in the Office Action.

Applicant accordingly requests withdrawal of the 35 U.S.C. §103 rejection of claims 79-83 and 100 as being unpatentable over Sheats et al. in view of JP06-136159A and Ritchie et al.

Conclusion

Applicant has made an earnest effort to address the rejection. Withdrawal thereof and allowance are requested. The Examiner is also requested to call the undersigned attorney if there are any questions regarding the application or this response.

Respectfully submitted on behalf of
3M Innovative Properties Company,

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Enc: Table of refractive indices for various polymers, from the web page at http://www.plasticsusa.com/refract.html as it appeared on October 12, 1999, as archived at http://web.archive.org/web/*/http://www.plasticsusa.com/refract.html

"Nitto Denko Develops Thermosetting Polymer with Highest Refractive Index", from the web page at http://www.japancorp.net/Article.Asp?Art_ID=5934.

All correspondence regarding this application should be directed to:

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REFRACTIVE INDEX for any substance is the ratio of the velocity of light in a vacuum to its velocity in the substance. It is also the ratio of the sine of the angle of incidence to the sine of the angle of refraction ASTM D642.

Fluorcarbon (FEP)	1.34 -
Polytetrafluoro--Ethylene (TFE)	1.35
Chlorotrifiuoro--Ethylene (CTFE)	1.42 -
Cellulose Propionate	1.46 -
Cellulose Acetate Butyrate	1.46 - 1.49
Cellulose Acetate	1.46 - 1.50
Methylpentene Polymer	1.485 -
Ethyl Cellulose	1.47 -
Acetal Homopolymer	1.48 -
Acrylics	1.49 -
Cellulose Nitrate	1.49 - 1.51
Polypropylene (Unmodified)	1.49 -
Polyallomer	1.492 -
Polybutylene	1.50 -
Ionomers	1.51 -
Polyethylene (Low Density)	1.51
Nylons (PA) Type II	1.52 -
Acrylics Multipolymer	1.52 -
Polyethylene (Medium Density)	1.52. -
Styrene Butadiene Thermoplastic	1.52 - 1.55
PVC (Rigid)	1.52. - 1.55
Nylons (Polyamide) Type 6/6	1.53 -
Urea Formaldehyde	1.54 - 1.58
Polyethylene (High Density)	1.54 -
Styrene Acrylonitrile Copolymer	1 .56 - 1.57
Polystyrene (Heat & Chemical)	1.57- 1.60
Polycarbornate (Unfilled)	1.586 -
Polystyrene (General Purpose)	1.59
Polysulfone	1 .633

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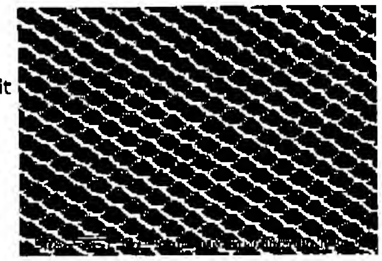
Nitto Denko Develops Thermosetting Polymer with Highest Refractive Index



Ibaraki, Japan, Nov 12, 2003 - (JCN Newswire) - Nitto Denko Corporation (TSE: 6988) is pleased to announce that it has succeeded in developing a new thermosetting polymer with a high refractive index. The new polymer has a refractive index of 1.76, the highest level in the world, and at the same time has excellent thermal resistance and processing properties as a thermosetting material.

Moreover, the addition of titania, zirconia, and other metal oxide nanoparticles with a high refractive index enables the design of other new materials with even higher refraction, and this will contribute to low power consumption and thinness through the enhancement of light emission-reception efficiency in equipment.

Based on the effective use of polymer properties, this material is expected to be used in a wide range of applications, including optical materials and optical communications-related optical materials for LCD, EL (electroluminescent), and other display devices, as well as luminous and photosensitive devices such as LEDs and CCDs.

Technology development background

The 21st century is the century of light and the century of the environment. Large-size LCD and plasma displays have formed markets, and organic EL displays have also begun to appear on the market. Furthermore, mass production of white LEDs has begun, and their luminous efficiency surpasses that of incandescent light bulbs and nearly surpasses that of fluorescent lamps.

One of the important technologies in the development of such new products is light control technology. Efficiently controlling light enhances the usage efficiency of light and enables high luminance as well as low power consumption. Moreover, in the case of CCDs used in digital cameras, there is a need to guarantee the amount of light received per pixel due to the contraction of pixel size associated with an increase in the number of pixels.

Optical polymers used in light emitting elements and CCDs require higher refractive indices to cope with such challenges. At the same time, superior processing and thermal resistance properties are also necessary to ensure the basic performance of materials incorporated in electronic components.

Advantages of this polymer

(1) Excellent luminous and photosensitive efficiency resulting from high refractive index

Highest refractive index level in the world: This polymer has a refractive index of 1.76. Compared with previous polymers, the refractive index has risen by 10-15%; for example, when used in LEDs, it will be possible to enhance luminous efficiency by about 30%. As a result, even higher luminance or a reduction in power consumption can be achieved.

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(2) Abundant processing and thermal resistance properties

In terms of its characteristics as a thermosetting material, this material has excellent processing and thermal resistance properties. In other words, by thermally molding this polymer film or powder, it is possible to mold it into a material of various shapes that has thermal resistance.

(3) Addition of other substances ensures even higher refraction

Adding titania, zirconia and other metal oxide nanoparticles with a high refractive index to this polymer has enabled the design of materials with even higher refraction.
By mixing titania with this polymer, Nitto Denko has already succeeded in developing a prototype material with a refractive index of 2.10.

Projected applications: Various applications can be expected, without being limited to those outlined below

(1) Element coating material for LEDs

It will be possible to improve the light emission and reception efficiency of white LEDs, which have been called the light of the 21st century.

(2) Antireflective films for display devices

It will be possible to improve the performance of antireflective films, which are used in LCD and other display devices.

(3) Microlenses for CCDs

It will be possible to increase the amount of light received, which facilitates the design of highly sensitive CCDs and high-definition CCDs. The creation of thin lenses will also contribute to the development of thinner equipment.

About Nitto Denko Corporation

Nitto Denko Corporation (TSE: 6988; US: NDEKY) is a company with an unchanging vision: creating new value precisely matched to the evolving needs of customers and the community. The Company was founded in 1918 as Japan's first manufacturer of electrical insulation materials. Capitalizing particularly on our Group strengths in polymer synthesis, application and processing technologies, Nitto Denko has constantly stayed at the leading edge in the development and implementation of an expanding range of advanced technologies that offer customers in countless fields the products they need when they need them. Consisting of 109 companies in 23 countries, the Nitto Denko Group is a continually evolving business organization that strives to enrich the quality of life worldwide through better products and technology.

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